well as a quantitative evaluation on the basis of retrospective data.

Proffered Papers: Physics 3: Anatomical CT and MR imaging for treatment preparation

OC-0153

Dual energy CT and iterative metal artefact reduction for accurate tumour delineation

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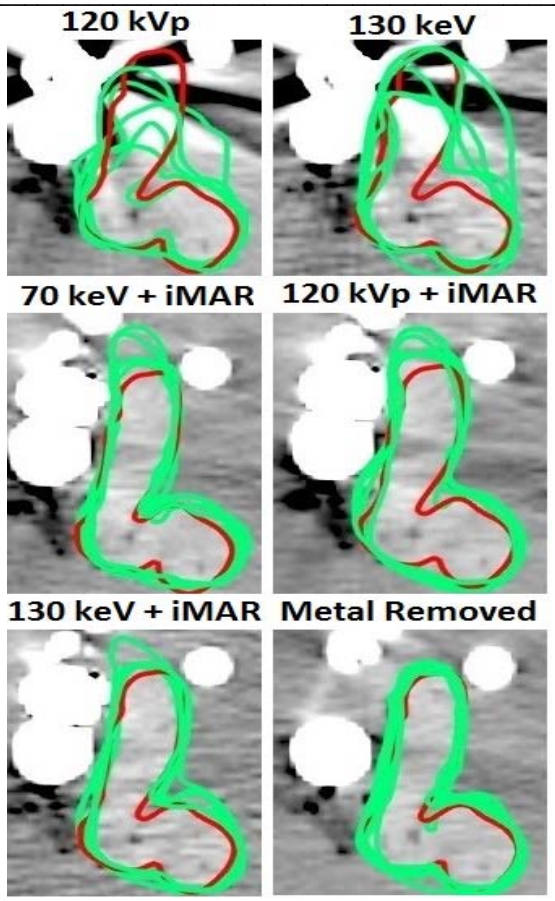
Purpose or Objective: To compare the accuracy of tumor delineation on a standard CT scan and on CT scans with two metal artifact reduction methods in an oral cavity phantom with a known tumor surrogate.

Material and Methods: A set of teeth containing an amalgam-filled removable tooth and an artificial polycaprolactone tumour was placed in water and CT scanned (Siemens Somatom Definition AS) at 120 kVp, 80 kVp, and 140 kVp. The two latter scans were used to reconstruct virtual monochromatic (VM) images. All image sets were additionally reconstructed with metal artefact reduction (MAR) software (iMAR, Siemens Healthcare). The following 4 MAR reconstructions were studied: 1) 130 keV VM 2) 70 keV VM with MAR, 3) 120 kVp with MAR, 4) 130 keV VM with MAR. A conventional 120 kVp CT was also taken and a 120 kVp image where the metal tooth was removed was used as control. 3 oncologists and 2 radiologists contoured the tumour volume on all 6 image sets while blinded to the image reconstruction type. A 7th high-quality image of only the artificial tumour was contoured to obtain the true shape of the tumour. Maximal Hausdorff distances and DICE coefficients of the 5 delineated contours compared to the true contour was were used to quantify delineation accuracy in all 6 image sets. Statistically, a Friedman-test was used for primary comparisons and a Nemenyi-test is performed for pairwise post hoc analysis.

Results: In all cases, MAR reconstructions clearly improved tumour delineation precision and accuracy (see Figure 1 and Table 1).The highest level of DICE similarity between observers was found based on 120 kVp iMAR reconstructions (DICE = 0,87 [0,86 – 0,88]), while the highest level of accuracy was found in the 130 keV iMAR reconstructions (Hausdorff max = 4,0 mm [2,9 – 8,1]). A statistical analysis comparing DICE coefficients and Hausdorff distances between modalities showed that contouring accuracy on the 120 kVp standard and 130 keV VM images were significantly degraded from the control image ($p < 0,05$ for both), whereas we found no significant differences between the control and the 70 keV VM iMAR, the 120 kVp iMAR and the 130 keV VM iMAR reconstructions. Verifying the model used for this study, a high level of precision and accuracy was observed (Hausdorff max = 2,9 mm (2,0 – 3,3) and DICE = 0,9 (0,89 – 0,92)) when no metal was present during the scan.



		Standard	Reconstruction Modality				Control
		120 kVp	130 keV	70 keV+iMAR	120 kVp + iMAR	130 keV + iMAR	120 kVp no metal
Haus-dorff max	Median (Range) [mm]	10,7 (6,3 – 14,5) *	9,8 (5,6 – 11,5)**	7,7 (4,1 – 9,2)	5,1 (3,9 – 8,6)	4,0 (2,9 – 8,1)	2,93 (2,0 – 3,3)
DICE	Median (Range)	0,75 (0,72 – 0,81)*	0,78 (0,75 – 0,80)*	0,84 (0,80 – 0,85)	0,87 (0,86 – 0,88)	0,88 (0,83 – 0,89)	0,9 (0,89 – 0,92)

Table 1 showing the median and range of maximal Hausdorff distances and DICE coefficients when comparing to the true contour. Statistical significance after a pairwise post-hoc Nemenyi test is shown as * ($p<0.01$) or ** ($p<0.05$)

Conclusion: MAR reconstructions resulted in a clear improvement in contouring accuracy compared to conventional CT and DECT VM images, where a significant degradation of tumour delineation accuracy was found in comparison to the control image. The highest level of similarity between observers was found in MAR reconstructions of 120 kVp, while 130 keV VM images showed potential to further improve accuracy when reconstructed with MAR software.

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Clinical use of dual-energy CT for proton treatment planning to reduce CT-based range uncertainties

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Purpose or Objective: To improve CT-based particle treatment planning the additional tissue information